

## CLAIMS

What is Claimed is:

1. A fuel cell system comprising:  
a fuel cell module including a cathode input responsive to a charge airflow and a cathode exhaust;  
a compressor generating the airflow applied to the cathode input of the fuel cell module;  
a surge detection device receiving the airflow sent to the compressor, said surge detection device generating a signal indicative of the direction of the airflow through the compressor; and  
a controller responsive to the signal from the surge protection device, said controller preventing compressor surge.
2. The system according to claim 1 wherein the compressor is a turbomachine compressor.
3. The system according to claim 2 wherein the compressor is selected from the group consisting of centrifugal, radial, axial and mixed flow compressors.
4. The system according to claim 1 wherein the surge protection device is a bi-directional mass flow meter.
5. The system according to claim 1 wherein the surge protection device is positioned upstream from the compressor, and receives the airflow before the compressor.
6. The system according to claim 1 further comprising a motor that drives the compressor, said controller providing a signal to the motor to control the speed of the compressor in response to the compressor surge.

7. The system according to claim 1 further comprising a back pressure valve positioned in the cathode exhaust, said back pressure valve controlling the pressure in the fuel cell module, said controller controlling the back pressure valve in response to the compressor surge.

8. The system according to claim 1 further comprising a by-pass valve in the cathode exhaust, said controller controlling the by-pass valve in response to the compressor surge.

9. The system according to claim 1 wherein the fuel cell system is on a vehicle.

10. A fuel cell system comprising:  
a fuel cell module including a cathode input responsive to a charge airflow and a cathode exhaust;  
a turbomachine compressor generating the charge airflow applied to the cathode input of the fuel cell module;  
a bi-directional mass flow meter responsive to the airflow prior to the airflow being applied to the compressor, said mass flow meter generating a signal indicative of the direction of the airflow through the compressor; and  
a controller responsive to the signal from the mass flow meter, said controller controlling the speed of the compressor so as to prevent a reverse flow of air through the compressor.

11. The system according to claim 10 wherein the compressor is selected from the group consisting of centrifugal, radial, axial and mixed flow compressors

12. The system according to claim 10 further comprising a back pressure valve positioned in the cathode exhaust, said back pressure valve controlling the pressure in the fuel cell module, said controller controlling the

back pressure valve in response to the reverse flow of air through the compressor.

13. The system according to claim 10 further comprising a by-pass valve positioned in the cathode exhaust, said controller opening the by-pass valve in response to the reverse flow of air through the compressor.

14. The system according to claim 10 wherein the fuel cell system is on a vehicle.

15. A method of detecting and eliminating a surge condition of a compressor in a fuel cell module, said method comprising:  
detecting a reverse air flow through the compressor; and  
preventing compressor surge in response to the detected reverse airflow.

16. The method according to claim 15 wherein preventing compressor surge includes increasing the speed of the compressor in response to the detected reverse airflow.

17. The method according to claim 15 wherein preventing compressor surge includes opening a back pressure valve in a cathode exhaust line of the fuel cell module in response to the detected reverse airflow.

18. The method according to claim 15 wherein preventing compressor surge includes opening a by-pass valve in a cathode exhaust line of the fuel cell module in response to the detected reverse airflow.

19. The method according to claim 15 wherein the compressor is a turbomachine compressor.

20. The method according to claim 15 wherein detecting a reverse airflow includes detecting a reverse airflow by a bi-directional mass flow meter.